CLAIMS

1. A monolithic photoreceiver, comprising

a common substrate;

vertically integrated cavity surface emitting lasers (VCSEL) as optical preamplifier; and

vertically integrated resonant tunneling bipolar transistor (RTBT) optical converters.

2. The monolithic photoreceiver as described in claim 1, wherein said VCSEL uses antimony-based distributed Bragg reflector (DBR), mirrors, and AlGaInAs/GaInAs active layers.

3. The monolithic photoreceiver as described in claim 2, where in DBR mirror pairs are selected from the group III-V compound semiconductor family consisting of : GaAs/(AlGaAs, GaInP, AlAs), (InP, GaInAsP, AlGaInAs, AlGaAsSb, TlGaInP, TlInP, TlGaInAs)/ (AlAsSb, AlInAsSb, AlGaAsSb, InP), GaInAsSb/AlGaInAsSb, GaAsSb/AlGaInAsSb, (InAs, GaSb, GaInSb, InAsSb)/(AlGaAsSb, AlSb, AlAsSb, AlGaSb), GaN/AlGaN, and GaInN/AlGaN.

4. The monolithic photoreceiver layers as described in claim 2, where in the active layers of the VCSOA are selected from the group III-V compound semiconductor family consisting of: (GaAs, TlGaInP, GaInAs, GaAsSb, GaAsN, GaInAsN)/(AlGaAs, GaInP, AlAs), (GaInAs, AlGaInAs, GaInAsP, GaAsSb, InAsP, TlGaInP, TlInP, TlGaInAs)/(InP, AlAsSb, AlInAsSb, AlGaAsSb, AlGaInAs), (GaSb, GInSb, InAs, InAsSb, GInAsSb)/(AlGaAsSb, AlSb, AlAsSb, AlGaSb) and (GaN, InN, GaInN)/ AGaN, AlN.

5. The monolithic photoreceiver as described in claim 2, wherein said layer are stacked on said substrate having an n-contact in the order of: an n-DBR stack, a cavity, a p-DBR stack, a p-stack and a contact.

6. The monolithic photoreceiver as described in claim 5, wherein said top DBR stacks on said cavity act as an integrated filter.

7. The monolithic photoreceiver as described in claim 1, wherein said RTBT is a multifunction device that is a combination of a resonant tunneling diode (RTD) and heterojunction bipolar transistor (HBT).

8. The monolithic photoreceiver as described in claim 7, wherein said RTBT comprises successive layers of: an N+HBT subcollector, an N HBT collector, a P+HBT base, an N HBT emitter, an N+RTD emitter, a first barrier, a well, a second barrier, and an N+RTD collector.

9. The monolithic photoreceiver as described in claim 7, wherein said optical converter comprises

a photodetector (PD), a transimpedance amplifier (TIA) and a buffer amplifier (BA).

10. The monolithic photoreceiver as described in claim 7, wherein all RTBTs are used as active elements in said optical converter.

11. The optical preamplifier concept and the monolithic integration approach as described in claim 1, wherein said monolithic photoreceiver are extensible to higher bit rates and other wavelengths.

12. The monolithic photoreceiver concept and the integration approach as described in claim 1, wherein said optical preamplifier and optical converter are integrated using wafer bonding, selective epitaxial, vertical epitaxial techniques.

13.The The monolithic photoreceiver concept and the integration approach as described in claim 1, wherein said optical preamplifier and optical converter are integrated using other material structures based on the group consisting of: InP, GaAs, GaSb, InAs, InSb, GaP, AlAs, AlSb, GaN, AlN, SiGe, Si and SiC technologies.

14. A monolithic photoreceiver, comprising

a common substrate;

vertically integrated cavity surface emitting lasers (VCSEL) as optical preamplifier; and

vertically integrated optical converters and

monolithically integrated TIA, control and decision circuits.

15. The monolithic photoreceiver as described in claim 14, wherein said optical converters are selected from the group of: PIN diode, resonant cavity enhanced photo diode (RCE); an avalanche photo diode (APD); PIN diode formed using base collector junction of the heterojunction bipolar transistor; a heterojunction phototransistor; resonant tunneling diode embedded in intrinsic layer of PIN diode; and a QWIP.

16. The monolithic photoreceiver as described in claim 14, wherein said optical converters is integrated with TIA, control and decision circuits.

17. The optical preamplifier concept and the monolithic integration approach as described in claim 14, wherein said monolithic photoreceiver are extensible to higher bit rates and other wavelengths.

18. The monolithic photoreceiver concept and the integration approach as described in claim 14, wherein said optical preamplifier and optical converter are integrated using wafer bonding, selective epitaxial, vertical epitaxial techniques.

19. The monolithic photoreceiver concept and the integration approach as described in claim 14 , wherein said optical preamplifier and optical converter are integrated using other material structures based on the group consisting of: InP, GaAs, GaSb, InAs, InSb, AlAs, AlSb, GaN, AlN, SiGe, Si and SiC technologies.

20. A monolithic photoreceiver array, comprising

a common substrate;

vertically integrated array of VCSOAs; and

vertically integrated array of optical converters and

monolithically integrated TIA, control and decision circuits.

21. The monolithic photoreceiver array as described in claim 20, wherein said array is formed by integrating arrays of VCSOAs and optical converters.

22. The monolithic photoreceiver array as described in claim 20, wherein said array is either a single or multiple wavelengths.

23. The monolithic photoreceiver array as described in claim 20, wherein said array is integrated with a single TIA, control and decision circuits.

24 The monolithic photoreceiver array as described in claim 20, wherein said each pixel in the array is integrated with TIA, control and decision circuits.

25. The monolithic photoreceiver as described in claim 20, wherein said each row in the array is integrated with TIA, control and decision circuits.

26. A monolithic optical source, comprising

a common substrate;

vertically integrated cavity surface emitting lasers (VCSEL) as optical preamplifier; and

vertically integrated cavity surface emitting lasers (VCSEL).

27. The monolithic optical source as described in claim 26, wherein said optical source is integrated with arrays of VCSEL and VCSOA and are phase locked.

28. The optical preamplifier concept and the monolithic integration approach as described in claim 26, wherein said monolithic optical sources are extensible to higher bit rates and other wavelengths.

29. The monolithic optical source concept and the integration approach as described in claim 26, wherein said optical preamplifier and VCSEL are integrated using wafer bonding, selective epitaxial,

vertical epitaxial techniques.

30. The monolithic optical source concept and the integration approach as described in claim 26, wherein said optical preamplifier and VCSEL are integrated using other material structures based on the group consisting of: InP, GaAs, GaSb, InAs, InSb, AlAs, AlSb, GaN, AlN, SiGe, Si and SiC technologies.

31. A monolithic optical amplifier, comprising:

a common substrate;

vertically integrated cavity surface emitting lasers (VCSEL) as optical preamplifier; and

vertically integrated cavity surface emitting lasers (VCSEL) as optical amplifier.

32. The monolithic optical preamplifier concept and the integration approach as described in claim 31, wherein said monolithic optical amplifier are extensible to higher bit rates and other wavelengths.

33. The monolithic optical amplifier concept and the integration approach as described in claim 31, wherein said optical preamplifier and optical amplifier are integrated using wafer bonding, selective epitaxial, vertical epitaxial techniques.

34. The monolithic optical amplifier concept and the integration approach as described in claim 31, wherein said optical preamplifier and optical amplifier are integrated using other material structures based on the group consisting of: InP, GaAs, GaSb, InAs, InSb, AlAs, AlSb, GaN, AlN, SiGe, Si and SiC technologies.

35. A monolithic efficient modulator, comprising

a common substrate;

vertically integrated cavity surface emitting lasers (VCSEL) as optical preamplifier; and

vertically integrated optical modulators and

monolithically integrated driver and control circuits.

36. The monolithic efficient modulator, as described in claim 35, wherein said optical modulator is an electro-optic modulator.

37. The monolithic efficient modulator, as described in claim 35, wherein said optical modulator is an electro-absorption modulator.

38. The optical preamplifier concept and the monolithic integration approach as described in claim 35, wherein said monolithic efficient modulators are extensible to higher bit rates and other

wavelengths.

39. The monolithic efficient modulator concept and the integration approach as described in claim 35, wherein said optical preamplifier and modulator are integrated using wafer bonding, selective epitaxial, vertical epitaxial techniques.

40. The monolithic efficient modulator concept and the integration approach as described in claim 35, wherein said optical preamplifier and modulator are integrated using other material structures based on the group consisting of: InP, GaAs, GaSb, InAs, InSb, AlAs, AlSb, GaN, AlN, SiGe, Si and SiC technologies.